

CLAIMS

What is claimed is:

1. A wireless communications device for a multiple input multiple output (MIMO) wireless communications system, comprising:

a radio frequency (RF) transceiver that includes at least two antennae; and

a medium access control (MAC) device that includes a link adaptation module that dynamically adjusts a bandwidth of said wireless communications device based on a transmission error rate and a correlation measurement at a remote wireless communications device.

2. The wireless communications device of Claim 1 wherein said link adaptation module includes a transmission error module that receives said transmission error rate from the remote wireless communications device and that generates a transmission error control signal based thereon.

3. The wireless communications device of Claim 2 wherein said transmission error module generates said transmission error control signal by comparing said transmission error rate to a predetermined error rate.

4. The wireless communications device of Claim 2 wherein said link adaptation module includes a signal correlation module that receives said correlation measurement from the remote wireless communication device and that generates a signal correlation control signal based thereon.

5. The wireless communications device of Claim 4 wherein said signal correlation module generates said signal correlation control signal by comparing said correlation measurement to a predetermined correlation measurement.

6. The wireless communications device of Claim 4 wherein said link adaptation module adjusts said bandwidth based on said transmission error control signal and said signal correlation control signal.

7. The wireless communications device of Claim 4 wherein said MAC device includes a space-time processor and wherein said link adaptation module adjusts an amount of spatial multiplexing that is executed by said space-time processor based on said transmission error control signal and said signal correlation control signal.

8. The wireless communications device of Claim 1 wherein said transmission error rate is one of a frame error rate (FER), a bit error rate (BER), a packet error rate (PER), and a signal quality (SQ) measurement.

9. The wireless communications device of Claim 1 wherein said correlation measurement is a rank of a channel matrix of the MIMO wireless communications system.

10. The wireless communications device of Claim 1 wherein said correlation measurement is an angle of array (AOA) of said signal at the wireless communications device.

11. The wireless communications device of Claim 1 wherein said correlation measurement is a received signal strength indicator (RSSI) that indicates a strength of said signal at the wireless communications device.

12. The wireless communications device of Claim 1 wherein said correlation measurement is based on a signal quality (SQ) measurement and a signal-to-noise ratio (SNR) of said signal at the wireless communications device.

13. The wireless communications device of Claim 1 wherein said link adaptation module increases said bandwidth when said transmission error rate is greater than a predetermined error rate.

14. The wireless communications device of Claim 7 wherein said link adaptation module decreases said amount of spatial multiplexing when said transmission error rate is greater than a predetermined error rate.

15. The wireless communications device of Claim 1 wherein said link adaptation module decreases said bandwidth when said transmission error rate is less than a predetermined error rate and said correlation measurement is less than a predetermined correlation measurement.

16. The wireless communications device of Claim 7 wherein said link adaptation module increases said amount of spatial multiplexing when said transmission error rate is less than a predetermined error rate and said correlation measurement is less than a predetermined correlation measurement.

17. The wireless communications device of Claim 7 wherein said space-time processor disables spatial multiplexing when said transmission error rate is greater than a predetermined error rate and said correlation measurement is greater than a predetermined correlation measurement.

18. The wireless communications device of Claim 17 wherein said link adaptation module adjusts one of a signal constellation size, a coding rate, and a transmit power of the wireless communications device to maintain a desired throughput.

19. The wireless communications device of Claim 1 wherein the remote wireless communications device generates at least one of said transmission error rate and said correlation measurement.

20. The wireless communications device of Claim 1 wherein the remote wireless communications device includes at least two antennae.

21. The wireless communications device of Claim 20 wherein a first number of antennae at the remote wireless communications device is at least as great as a second number of antennae at said RF transceiver.

22. The wireless communications device of Claim 7 wherein said space-time processor executes a MIMO modulation system that includes spatial multiplexing.

23. The wireless communications device of Claim 22 wherein said MIMO modulation system further includes space-time coding.

24. The wireless communications device of Claim 1 wherein the wireless communications device is otherwise compliant with at least one of IEEE 802.11, 802.11a, 802.11g, 802.11n, and 802.16.

25. A link adaptation module for a wireless communications device in a multiple input multiple output (MIMO) wireless communications system, comprising:

a transmission error module that generates a transmission error control signal based on a transmission error rate at a remote wireless communications device; and

a signal correlation module that generates a signal correlation control signal based on a correlation measurement of a received signal at the remote wireless communications device,

wherein said link adaptation module dynamically adjusts a bandwidth of the wireless communications device based on said transmission error control signal and said signal correlation control signal.

26. The link adaptation module of Claim 25 wherein said transmission error module generates said transmission error control signal by comparing said transmission error rate to a predetermined error rate.

27. The link adaptation module of Claim 25 wherein said signal correlation module generates said signal correlation control signal by comparing said correlation measurement to a predetermined correlation measurement.

28. A system comprising the link adaptation module of Claim 25 and further comprising a space-time processor, wherein said link adaptation module adjusts an amount of spatial multiplexing that is executed by said space-time processor based on said transmission error control signal and said signal correlation control signal.

29. The link adaptation module of Claim 25 wherein said transmission error rate is one of a frame error rate (FER), a bit error rate (BER), a packet error rate (PER), and a signal quality (SQ) measurement.

30. The link adaptation module of Claim 25 wherein said correlation measurement is a rank of a channel matrix of the MIMO wireless communications system.

31. The link adaptation module of Claim 25 wherein said correlation measurement is an angle of array (AOA) of said signal at the remote receiver.

32. The link adaptation module of Claim 25 wherein said correlation measurement is a received signal strength indicator (RSSI) that indicates a strength of said signal at the wireless communications device.

33. The link adaptation module of Claim 25 wherein said correlation measurement is based on a signal quality (SQ) measurement and a signal-to-noise ratio (SNR) of said signal at the remote wireless communications device.

34. The link adaptation module of Claim 25 wherein said link adaptation module increases said bandwidth when said transmission error rate is greater than a predetermined error rate.

35. The system of Claim 28 wherein said link adaptation module decreases said amount of spatial multiplexing when said transmission error rate is greater than a predetermined error rate.

36. The link adaptation module of Claim 25 wherein said link adaptation module decreases said bandwidth when said transmission error rate is less than a predetermined error rate and said correlation measurement is less than a predetermined correlation measurement.

37. The system of Claim 28 wherein said link adaptation module increases said amount of spatial multiplexing when said transmission error rate is less than a predetermined error rate and said correlation measurement is less than a predetermined correlation measurement.

38. The system of Claim 28 wherein said space-time processor disables spatial multiplexing when said transmission error rate is greater than a predetermined error rate and said correlation measurement is greater than a predetermined correlation measurement.

39. The system of Claim 38 wherein said link adaptation module adjusts one of a signal constellation size, a coding rate, and a transmit power of the wireless communications device to maintain a desired throughput.

40. The link adaptation module of Claim 25 wherein said link adaptation module is implemented in a medium access control (MAC) device of the wireless communications device.

41. The link adaptation module of Claim 25 wherein the remote wireless communications device generates at least one of said transmission error rate and said correlation measurement.

42. The link adaptation module of Claim 25 wherein the wireless communications device includes at least two antennae and the remote wireless communications device includes at least two antennae.

43. The link adaptation module of Claim 42 wherein a first number of antennae at the remote wireless communications device is at least as great as a second number of antennae at the wireless communications device.

44. The system of Claim 28 wherein said space-time processor executes a MIMO modulation system that includes spatial multiplexing.

45. The system of Claim 44 wherein said MIMO modulation system further includes space-time coding.

46. The link adaptation module of Claim 25 wherein the link adaptation module is otherwise compliant with at least one of IEEE 802.11, 802.11a, 802.11g, 802.11n, and 802.16.

47. A wireless communications device for a multiple input multiple output (MIMO) wireless communications system, comprising:

radio frequency (RF) transceiving means for transmitting and receiving wireless data and that includes at least two antennae; and

link adaptation means for dynamically adjusting a bandwidth of said wireless communications device based on a transmission error rate and a correlation measurement at a remote wireless communications device.

48. The wireless communications device of Claim 47 wherein said link adaptation means includes transmission error generating means for receiving said transmission error rate from the remote wireless communications device and for generating a transmission error control signal based thereon.

49. The wireless communications device of Claim 48 wherein said transmission error generating means generates said transmission error control signal by comparing said transmission error rate to a predetermined error rate.

50. The wireless communications device of Claim 48 wherein said link adaptation means includes signal correlation generating means for receiving said correlation measurement from the remote wireless communication device and for generating a signal correlation control signal based thereon.

51. The wireless communications device of Claim 50 wherein said signal correlation generating means generates said signal correlation control signal by comparing said correlation measurement to a predetermined correlation measurement.

52. The wireless communications device of Claim 50 wherein said link adaptation means adjusts said bandwidth based on said transmission error control signal and said signal correlation control signal.

53. The wireless communications device of Claim 50 further comprising space-time processing means for providing a variable amount of spatial multiplexing, wherein said link adaptation means adjusts said amount of spatial multiplexing based on said transmission error control signal and said signal correlation control signal.

54. The wireless communications device of Claim 47 wherein said transmission error rate is one of a frame error rate (FER), a bit error rate (BER), a packet error rate (PER), and a signal quality (SQ) measurement.

55. The wireless communications device of Claim 47 wherein said correlation measurement is a rank of a channel matrix of the MIMO wireless communications system.

56. The wireless communications device of Claim 47 wherein said correlation measurement is an angle of array (AOA) of said signal at the wireless communications device.

57. The wireless communications device of Claim 47 wherein said correlation measurement is a received signal strength indicator (RSSI) that indicates a strength of said signal at the wireless communications device.

58. The wireless communications device of Claim 47 wherein said correlation measurement is based on a signal quality (SQ) measurement and a signal-to-noise ratio (SNR) of said signal at the wireless communications device.

59. The wireless communications device of Claim 47 wherein said link adaptation means increases said bandwidth when said transmission error rate is greater than a predetermined error rate.

60. The wireless communications device of Claim 53 wherein said link adaptation means decreases said amount of spatial multiplexing when said transmission error rate is greater than a predetermined error rate.

61. The wireless communications device of Claim 47 wherein said link adaptation means decreases said bandwidth when said transmission error rate is less than a predetermined error rate and said correlation measurement is less than a predetermined correlation measurement.

62. The wireless communications device of Claim 53 wherein said link adaptation means increases said amount of spatial multiplexing when said transmission error rate is less than a predetermined error rate and said correlation measurement is less than a predetermined correlation measurement.

63. The wireless communications device of Claim 53 wherein said space-time processing means disables spatial multiplexing when said transmission error rate is greater than a predetermined error rate and said correlation measurement is greater than a predetermined correlation measurement.

64. The wireless communications device of Claim 63 wherein said link adaptation means adjusts one of a signal constellation size, a coding rate, and a transmit power of the wireless communications device to maintain a desired throughput.

65. The wireless communications device of Claim 47 wherein the remote wireless communications device generates at least one of said transmission error rate and said correlation measurement.

66. The wireless communications device of Claim 47 wherein the remote wireless communications device includes at least two antennae.

67. The wireless communications device of Claim 66 wherein a first number of antennae at the remote wireless communications device is at least as great as a second number of antennae at said RF transceiving means.

68. The wireless communications device of Claim 53 wherein said space-time processing means executes a MIMO modulation system that includes spatial multiplexing.

69. The wireless communications device of Claim 68 wherein said MIMO modulation system further includes space-time coding.

70. The wireless communications device of Claim 47 wherein the wireless communications device is otherwise compliant with at least one of IEEE 802.11, 802.11a, 802.11g, 802.11n, and 802.16.

71. A link adaptation module for a wireless communications device in a multiple input multiple output (MIMO) wireless communications system, comprising:

transmission error generating means for generating a transmission error control signal based on a transmission error rate at a remote wireless communications device; and

signal correlation generating means for generating a signal correlation control signal based on a correlation measurement of a received signal at the remote wireless communications device,

wherein said link adaptation module dynamically adjusts a bandwidth of the wireless communications device based on said transmission error control signal and said signal correlation control signal.

72. The link adaptation module of Claim 71 wherein said transmission error generating means generates said transmission error control signal by comparing said transmission error rate to a predetermined error rate.

73. The link adaptation module of Claim 71 wherein said signal correlation generating means generates said signal correlation control signal by comparing said correlation measurement to a predetermined correlation measurement.

74. A system comprising the link adaptation module of Claim 71 and further comprising space-time processing means for providing a variable amount of spatial multiplexing, wherein said link adaptation module adjusts said amount of spatial multiplexing based on said transmission error control signal and said signal correlation control signal.

75. The link adaptation module of Claim 71 wherein said transmission error rate is one of a frame error rate (FER), a bit error rate (BER), a packet error rate (PER), and a signal quality (SQ) measurement.

76. The link adaptation module of Claim 71 wherein said correlation measurement is a rank of a channel matrix of the MIMO wireless communications system.

77. The link adaptation module of Claim 71 wherein said correlation measurement is an angle of array (AOA) of said signal at the remote receiver.

78. The link adaptation module of Claim 71 wherein said correlation measurement is a received signal strength indicator (RSSI) that indicates a strength of said signal at the wireless communications device.

79. The link adaptation module of Claim 71 wherein said correlation measurement is based on a signal quality (SQ) measurement and a signal-to-noise ratio (SNR) of said signal at the remote wireless communications device.

80. The link adaptation module of Claim 71 wherein said link adaptation module increases said bandwidth when said transmission error rate is greater than a predetermined error rate.

81. The system of Claim 74 wherein said link adaptation module decreases said amount of spatial multiplexing when said transmission error rate is greater than a predetermined error rate.

82. The link adaptation module of Claim 71 wherein said link adaptation module decreases said bandwidth when said transmission error rate is less than a predetermined error rate and said correlation measurement is less than a predetermined correlation measurement.

83. The system of Claim 74 wherein said link adaptation module increases said amount of spatial multiplexing when said transmission error rate is less than a predetermined error rate and said correlation measurement is less than a predetermined correlation measurement.

84. The system of Claim 74 wherein said space-time processing means disables spatial multiplexing when said transmission error rate is greater than a predetermined error rate and said correlation measurement is greater than a predetermined correlation measurement.

85. The system of Claim 84 wherein said link adaptation module adjusts one of a signal constellation size, a coding rate, and a transmit power of the wireless communications device to maintain a desired throughput.

86. The link adaptation module of Claim 71 wherein said link adaptation module is implemented in a medium access control (MAC) device of the wireless communications device.

87. The link adaptation module of Claim 71 wherein the remote wireless communications device generates at least one of said transmission error rate and said correlation measurement.

88. The link adaptation module of Claim 71 wherein the wireless communications device includes at least two antennae and the remote wireless communications device includes at least two antennae.

89. The link adaptation module of Claim 88 wherein a first number of antennae at the remote wireless communications device is at least as great as a second number of antennae at the wireless communications device.

90. The system of Claim 74 wherein said space-time processing means executes a MIMO modulation system that includes spatial multiplexing.

91. The system of Claim 90 wherein said MIMO modulation system further includes space-time coding.

92. The link adaptation module of Claim 71 wherein the link adaptation module is otherwise compliant with at least one of IEEE 802.11, 802.11a, 802.11g, 802.11n, and 802.16.

93. A method for operating a wireless communications device, comprising:

providing a multiple input multiple output (MIMO) wireless communications system; and

dynamically adjusting a bandwidth of said wireless communications device based on a transmission error rate and a correlation measurement at a remote wireless communications device.

94. The method of Claim 93 further comprising generating a transmission error rate control signal based on said transmission error rate before said adjusting step, wherein said wireless communications device receives said transmission error rate from the remote wireless communications device.

95. The method of Claim 94 further comprising generating said transmission error control signal by comparing said transmission error rate to a predetermined error rate.

96. The method of Claim 94 further comprising generating a signal correlation control signal based on said correlation measurement before said adjusting step, wherein said wireless communications device receives said correlation measurement from the remote wireless communication device.

97. The method of Claim 96 further comprising generating said signal correlation control signal by comparing said correlation measurement to a predetermined correlation measurement.

98. The method of Claim 96 further comprising adjusting said bandwidth based on said transmission error control signal and said signal correlation control signal.

99. The method of Claim 96 further comprising adjusting an amount of spatial multiplexing that is executed by a space-time processor in said wireless communications device based on said transmission error control signal and said signal correlation control signal.

100. The method of Claim 93 wherein said transmission error rate is one of a frame error rate (FER), a bit error rate (BER), a packet error rate (PER), and a signal quality (SQ) measurement.

101. The method of Claim 93 wherein said correlation measurement is a rank of a channel matrix of the MIMO wireless communications system.

102. The method of Claim 93 wherein said correlation measurement is an angle of array (AOA) of said signal at the wireless communications device.

103. The method of Claim 93 wherein said correlation measurement is a received signal strength indicator (RSSI) that indicates a strength of said signal at the wireless communications device.

104. The method of Claim 93 wherein said correlation measurement is based on a signal quality (SQ) measurement and a signal-to-noise ratio (SNR) of said signal at the wireless communications device.

105. The method of Claim 93 further comprising increasing said bandwidth when said transmission error rate is greater than a predetermined error rate.

106. The method of Claim 99 further comprising decreasing said amount of spatial multiplexing when said transmission error rate is greater than a predetermined error rate.

107. The method of Claim 93 further comprising decreasing said bandwidth when said transmission error rate is less than a predetermined error rate and said correlation measurement is less than a predetermined correlation measurement.

108. The method of Claim 99 further comprising increasing said amount of spatial multiplexing when said transmission error rate is less than a predetermined error rate and said correlation measurement is less than a predetermined correlation measurement.

109. The method of Claim 99 further comprising disabling spatial multiplexing when said transmission error rate is greater than a predetermined error rate and said correlation measurement is greater than a predetermined correlation measurement.

110. The method of Claim 109 further comprising adjusting one of a signal constellation size, a coding rate, and a transmit power of the wireless communications device to maintain a desired throughput.

111. The method of Claim 93 wherein the remote wireless communications device generates at least one of said transmission error rate and said correlation measurement.

112. The method of Claim 93 wherein the remote wireless communications device includes at least two antennae.

113. The method of Claim 112 wherein a first number of antennae at the remote wireless communications device is at least as great as a second number of antennae at said wireless communications device.

114. The method of Claim 99 wherein said space-time processor executes a MIMO modulation system that includes spatial multiplexing.

115. The method of Claim 114 wherein said MIMO modulation system further includes space-time coding.

116. The method of Claim 93 wherein the wireless communications device is otherwise compliant with at least one of IEEE 802.11, 802.11a, 802.11g, 802.11n, and 802.16.

117. A method for operating a link adaptation module for a wireless communications device in a multiple input multiple output (MIMO) wireless communications system, comprising:

generating a transmission error control signal based on a transmission error rate at a remote wireless communications device;

generating a signal correlation control signal based on a correlation measurement of a received signal at the remote wireless communications device; and

dynamically adjusting a bandwidth of the wireless communications device based on said transmission error control signal and said signal correlation control signal.

118. The method of Claim 117 further comprising generating said transmission error control signal by comparing said transmission error rate to a predetermined error rate.

119. The method of Claim 117 further comprising generating said signal correlation control signal by comparing said correlation measurement to a predetermined correlation measurement.

120. The method of Claim 117 further comprising adjusting an amount of spatial multiplexing that is executed by a space-time processor based on said transmission error control signal and said signal correlation control signal.

121. The method of Claim 117 further comprising selecting one of a frame error rate (FER), a bit error rate (BER), a packet error rate (PER), and a signal quality (SQ) measurement as said transmission error rate.

122. The method of Claim 117 further comprising selecting a rank of a channel matrix of the MIMO wireless communications system as said correlation measurement.

123. The method of Claim 117 further comprising selecting an angle of array (AOA) of said signal at the remote receiver as said correlation measurement.

124. The method of Claim 117 further comprising selecting a received signal strength indicator (RSSI) that indicates a strength of said signal at the wireless communications device as said correlation measurement.

125. The method of Claim 117 further comprising basing said correlation measurement on a signal quality (SQ) measurement and a signal-to-noise ratio (SNR) of said signal at the remote wireless communications device.

126. The method of Claim 117 further comprising increasing said bandwidth when said transmission error rate is greater than a predetermined error rate.

127. The method of Claim 120 further comprising decreasing said amount of spatial multiplexing when said transmission error rate is greater than a predetermined error rate.

128. The method of Claim 117 further comprising decreasing said bandwidth when said transmission error rate is less than a predetermined error rate and said correlation measurement is less than a predetermined correlation measurement.

129. The method of Claim 120 further comprising increasing said amount of spatial multiplexing when said transmission error rate is less than a predetermined error rate and said correlation measurement is less than a predetermined correlation measurement.

130. The method of Claim 120 further comprising disabling spatial multiplexing when said transmission error rate is greater than a predetermined error rate and said correlation measurement is greater than a predetermined correlation measurement.

131. The method of Claim 130 further comprising adjusting one of a signal constellation size, a coding rate, and a transmit power of the wireless communications device to maintain a desired throughput.

132. The method of Claim 117 further comprising implementing said link adaptation module in a medium access control (MAC) device of the wireless communications device.

133. The method of Claim 117 wherein the remote wireless communications device generates at least one of said transmission error rate and said correlation measurement.

134. The method of Claim 117 wherein the wireless communications device includes at least two antennae and the remote wireless communications device includes at least two antennae.

135. The method of Claim 134 wherein a first number of antennae at the remote wireless communications device is at least as great as a second number of antennae at the wireless communications device.

136. The method of Claim 120 wherein said space-time processor executes a MIMO modulation system that includes spatial multiplexing.

137. The method of Claim 136 wherein said MIMO modulation system further includes space-time coding.

138. The method of Claim 117 wherein the link adaptation module is otherwise compliant with at least one of IEEE 802.11, 802.11a, 802.11g, 802.11n, and 802.16.